DAV UNIVERSITY

+91 - 181- 270 8844 Telephone
naac@davuniversity.org E-mail
www.davuniversity.org Website

3.7.1.1: Number of functional MoUs with institutions/ industries in India and abroad for internship, on-the-job training, project work, student / faculty exchange and collaborative research during the last five years

Index - 2019-2020

3.	2019-2020	Punjab Energy Development Agency, Chandigarh	Perpetual	Research & Development Projects on Energy Conservation & Energy Efficiency under "State Energy Efficiency Reseach & Outreach Program" of Bureau of Energy Effciency, Ministry of Power, Government of India	1. Student visit to Punjab Energy Development Agency, Chandigarh 2. PEDA training programme on energy conservation	13
4.	2019-2020	ICAR - Central Soil Salinity Research Institute, Karnal	Five years	For Collaboration for Post Graduate Research	Student visit at CSSRI Karnal	19
5.	2019-2020	Department of Science, Technology & Environment, Govt. of Punjab, Chandigarh	Five years	To develop model villages in the vicinity of DAV University	Model development of village Sangowal	20
6.	2019-20	UNIVERSITY OF KASHMIR	Perpetual	Research Collaboration	Publication	22
7.	2019-20	MIT-ADT University	Perpetual	Research Collaboration	Publication	34
8.	2019-20	Jamia Millia Islamia	Perpetual	Research Collaboration	Publication	46

Activity -1

1. **Name of Event: 5-Day training on "Value Addition to Summer crops for Preservation":**

   Date: 12 July 2022

It was organized by DAV University on 12 July, 2022 in collaboration with NIT Jalandhar and Krishi Vigyan Kendra, Nurmahal; Department of Agriculture and Farmer Welfare, Jalandhar funded by Punjab State Council for Science & Technology, Department of Science and Technology, Government of India. A total of 30 participants attended the program.

The participants interacting with the experts of DAV University

Training session to the participants by the experts of DAV University

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ਲੜੀ ਨੰ.	ਮੈਂਬਰ ਦਾ ਨਾਂ	ਪਿਤਾ/ਪਤਨੀ/ਪਤੀ ਦਾ ਨਾਂ	ਜਨਮ ਮਿਤੀ/ GEN/SC/ST/OBC	ਦਸਤਖਤ
1	ਪੂਜਾ	ਸ਼੍ਰੀ ਹਰੀਸ਼ ਕੁਮਾਰ	10/12/1997 BC	Pooja
2	ਬਲਿੰਦਰ ਕੌਰ	ਸ਼੍ਰੀ ਮਿੱਠੀ ਕੁਮਾਰ	09/12/1982 GN	Balinder kaur
3	ਸੰਦੀਪ ਕੌਰ	ਸ਼੍ਰੀ ਸੰਜੀਵ ਕੁਮਾਰ	05/10/1985 GN	Sandeep
4	ਰਾਜ ਕੁਮਾਰੀ	ਸ਼੍ਰੀ ਰਾਮ ਕੁਮਾਰ	15/7/1986 SC	Rajkumari
5	ਪਰਮਿੰਦਰ ਕੌਰ	ਸ਼੍ਰੀ ਗੁਰਮੁਖ ਸਿੰਘ	12/9/1994 SC	Parminderkau
6	ਰਵਿੰਦਰ ਕੌਰ	ਸ਼੍ਰੀ ਹਰੀਸ਼ ਕੁਮਾਰ	29/12/1975 SC	Ravinder kau
7	ਜਸਵੀਰ ਕੌਰ	ਸ਼੍ਰੀ ਬਲਵਿੰਦਰ ਸਿੰਘ	15/3/1970 GN	Jasviram
8	ਕਮਲੇਸ਼ ਰਾਣੀ	ਸ਼੍ਰੀ ਰੂਪ ਲਾਲ	25/12/1978 SC	Kamlesh Rani
9	ਮੀਨਾ ਰਾਣੀ	ਸ਼੍ਰੀ ਰਾਮ ਲਾਲਜੀ	13/01/1983 SC	ਮੀਨਾ ਰਾਣੀ
10	ਗੁਰਬਖਸ਼ ਕੌਰ	ਸ਼੍ਰੀ ਚੰਡਨ ਦਾਸ	13/7/1979 SC	ਗੁਰਬਖਸ਼ ਕੌਰ

Activity -2

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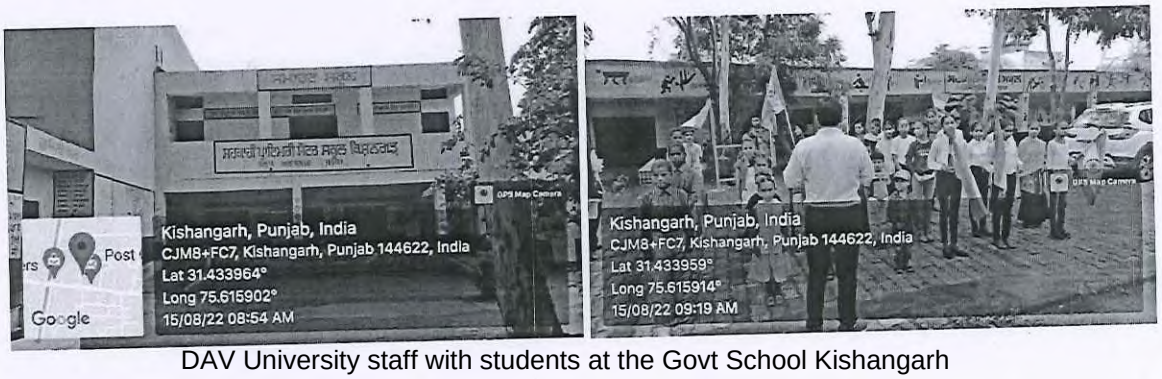
Activity -2

2. **Name of Event: Awareness campaign for National integration at village Kishangarh.**

   Department : Zoology

   Date: 15 August 2022

It was organized by DAV University on 15 August, 2022 in collaboration with NIT Jalandhar funded by Punjab State Council for Science & Technology, Department of Science and Technology, Government of India. A total of 50 participants attended the program in the village Kishangarh.



DAV University staff with students at the Govt School Kishangarh

DAV University staff with villagers at the Govt School Kishangarh

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Activity -3

3. **Name of event: Swachta Pakhwara at village Nussi, Jalandhar**

   Department of Zoology

   Date : 13 September 2022

It was organized by DAV University on 13 September, 2022 in collaboration with Govt. High School, Nussi, NIT Jalandhar funded by Punjab State Council for Science & Technology, Department of Science and Technology, Government of India. A total of 68 participants attended the program in the village Nussi, Jalandhar.

G. H. S., Nussi (Jalandhar)

1.	Diya	(10th)
2	Jasmeen Bhatti	"
3.	Rohit	"
4	Gautam Dugg	"
5	Anmoldeep kaur	"
6	Heena	"
7.	Manpreet kaur	"
8	Muskan	"
9	Nishant Dugg	"
10	Simran	"
11.	Jatin Bhatti	"
12.	Manvi	"
13	Damanpreet kaur	(9th)
14	Vaishnavi	"
15	Gurleen	"
16	Nishu	"
17	Sourav	"
18	Nargis	"
19	Amanjit Singh	"
20	Nishant Bhatti	"
21	Jashanpreet	"
22	Amanpreet kaur	"
23	Japneet kaur	(8th)
24	Lovejot	"
25	Prabhjot	"
26	Shapal	"
27	Naman	"
28	Saloni Bhatti	"
29	Anjali	"
30	Sahil Dugg	"
31	Harsh Dugg	(8th)
32	Dishant	"
33	Ravinder Singh	"
34	Manjot	(7th)
35	Lalita	(8th)
36	Rajwinder	"
37	Harpreet Rai	"
38	Yash kumar	"
39	Jasleen	"
40	Chetan	"
41	Kartik Bangar	(7th)
42	Ddbag Rai	"
43	Anita	"
44	Jaskaran	"
45	Vivek	"
46	Anjani	"
47	Yogesh	"
48	Nidhi	"
49	Abnoor	"
50	Laxmi	(6th)
51	Arpita	(6th)
52	Khushi kumari	"
53	Herry	"
54	Harry Duggal	"
55	Harman	"
56	Sonam	"
57	Navjot	"
58	Paramveer	"
59	Radhika	"
60	Suraj kumar	"

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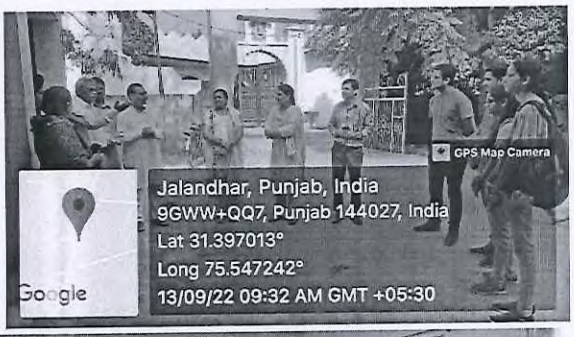
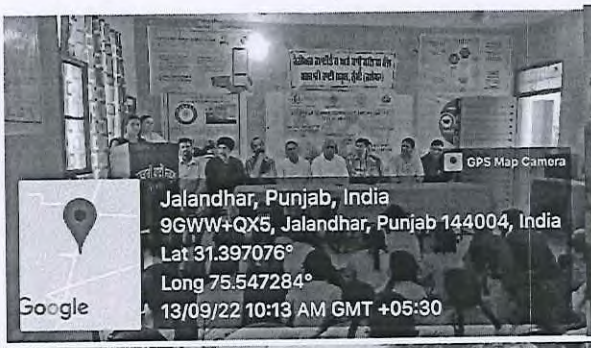
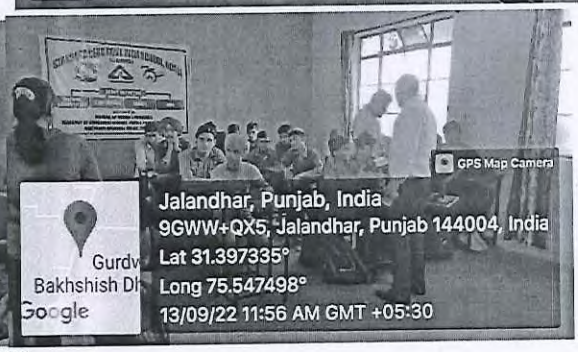
61	Bhavjit	(6th)
62	Nitesh	"
63	Rahul	"
64	Beauty kumari	"
65	Gayatri kumari	"
66	Nishu	"
67	Shiv kumar	"
68	Jaismeen	"







DAV University staff lecturing students and villagers at the Govt School in Nussi

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Activity -4

4. **Name of Event: Enterpreneurship Assistance Program (EAP) in Village Karari**

Department : Zoology

Date: (13-14/09/2022)

It was organized by DAV University in the year 2022 in collaboration with NIT Jalandhar funded by ICICI Foundation and Punjab State Council for Science & Technology, Department of Science and Technology, Government of India. A total of 31 participants attended the program.

Attach Attendance of the participants on plain paper in following format and attach along with the EAP Report
(Attach additional sheet if required)

Sr. No.	Name of the Participant	Age	Male / Female	First Preference of training	Second preference of training	Mobile Number	Signature of Participant
1	Seema Rani	37	F	Mushroom	Spices	9501712742	Seema Rani
2	Raj Kumari	25	F	MC	Organic farming	7347485933	Raj Kumari
3	Parminder Kaur	38	F	MC	Spices	7529973103	Parminder Kaur
4	Tarsem Kaur	51	F	MC	Bakery	9815949127	[illegible]
5	Kulwinder Kaur	46	F	MC	Spices	9915732394	[illegible]
6	Santosh Kumari	48	F	MC	Spices	9779096437	[illegible]
7	Jaspreet Kaur	30	F	MC	Spice	9814343877	[illegible]
8	Kamal	31	F	MC	Bakery	9915829149	[illegible]
9	Jaspreet	42	F	MC	Spices	9501122798	[illegible]
10	Baljinder Kaur	37	F	MC	Bakery	8427361526	[illegible]
11	Sandeep Kaur	37	F	MC	Bakery	7779564067	Sandeep
12	Pooja	25	F	MC	Bakery	9041620091	[illegible]
13	Gurbakash Kaur	43	F	MC	Spices Sauce	9815171445	[illegible]
14	Surinder Kaur	60	F	MC	Sauce	9877797022	[illegible]
15	Raj Rani	72	F	MC	Spices	9814868801	
16	Ram Pyari	65	F	MC	Spices	8146295355	
17	Amarjeet Kaur	50	F	MC	Spices	9815428951	[illegible]
18	Baljinder Kaur	56	F	MC	Spices	7007600479	Baljinder Kaur
19	Parveen Rani	35	F	MC	Bio Product & ...	8146198020	Parveen Rani
20	Praveen Kumari	36	F	MC	Spices	9877203603	Praveen Kumari
21	Raj Kumari	30	F	MC	Spices	8283924690	[illegible]
22	Sukhvinder Kaur	36	F	MC	Spices	9872364147	[illegible]
23	Sarabjeet Kaur	36	F	MC	Spices	9915367920	Sarbjit Kaur
24	Shambu Ram	63	M	MC	Spices	9914390537	[illegible]
25	Bimla Rani	60	F	MC	Spices		Bimla Rani

21

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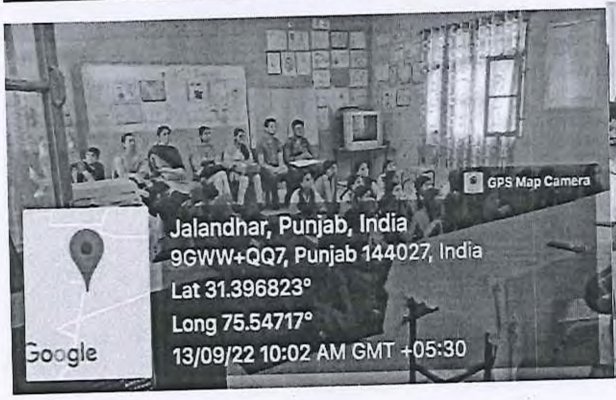
DAV University, Jalandhar

ICICI Foundation

Attach Attendance of the participants on plain paper in following format and attach along with the EAP Report
(Attach additional sheet if required)

Sr. No.	Name of the Participant	Age	Male / Female	First Preference of training	Second preference of training	Mobile Number	Signature of Participant
				MC	[illegible]	[illegible]	[illegible]
26	Rishma Kaur	55	F	MC	[illegible]	[illegible]	[illegible]
27	Ram Asra	63	M	MC	[illegible]	[illegible]	[illegible]
28	Sunita Rani	60	F	MC	[illegible]	[illegible]	[illegible]
29	Asha Rani	48	F	MC	[illegible]	[illegible]	[illegible]
30	Laxmi	48	F	MC	[illegible]	[illegible]	[illegible]
31	[illegible]	43	F		[illegible]		



Members of self help group and DAV university students

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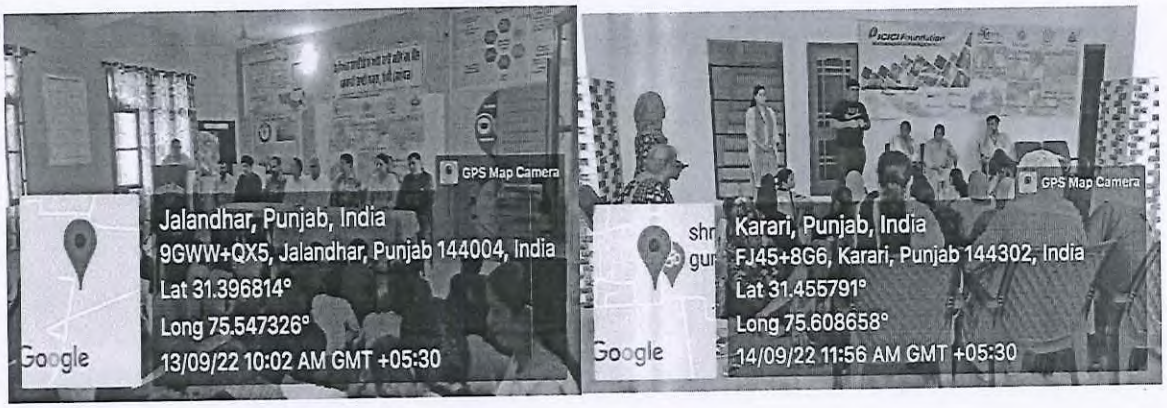

Members of self help group attending lecture by DAV university staff

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Activity -5

5. **Name of Event: Enterpreneurship Assistance Program (EAP) in Village Nussi**

   Department : Zoology

   Date: 29 September, 2022

It was organized by DAV University on 29 September, 2022 in collaboration with NIT Jalandhar funded by ICICI Foundation and Punjab State Council for Science & Technology, Department of Science and Technology, Government of India. A total of 35 participants attended the program in village Nussi.

ICICI Foundation

Attach Attendance of the participants on plain paper in following format and attach alongwith the EAP Report (Attach additional sheet if required)

Sr. No.	Name of the Participant	Age	Male / Female	First Preference of training	Second preference of training	Mobile Number	Signature of Participant
1	Rashi Rani	30	M			-	-
2	Ramesh Ram	60	M			-	
3	Meena	46	F			-	
4	Sunita Rani	45	F			8427551930	
5	Sheelam	30	F			7696325659	
6	Neetu Rani	32	F			9872745328	
7	Pushpa	40	F			- -	
8	Roopna	45	F			-	
9	Ramesha	60	F			-	
10	Raj Rani	18	F			-	
11	Jeeto	70	F			- -	
12	Kajal	35	F			9855991414	
13	Geeta Rani	32	F			9781764761	
14	Seema Devi	40	F			7340974837	
15	Amrmeet Kaur	50	F			-	
16	Tejbeer Kaur	60	F			-	
17	Nirmala	40	F			8872455956	
18	Baljinder Kaur	45	F			9653250905	
19	Akhil Sharma	32	M			78885 33219	
20	Harvinder Kaur	28	F			9915731993	
21	Sandesh Kumari	32	F				

Members of self help group attending the EAP details

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DAV University, Jalandhar

Activity -6

6. **Name of Event: Enterpreneurship Assistance Program (EAP) in Village Sarmastpur**

   Department : Zoology

   Date: 30 September 2022

It was organized by DAV University on 30 September, 2022 in collaboration with NIT Jalandhar funded by ICICI Foundation and Punjab State Council for Science & Technology, Department of Science and Technology, Government of India. A total of 22 participants attended the program in village Sarmastpur.

ICICI Foundation

Attach Attendance of the participants on plain paper in following format and attach alongwith the EAP Report
(Attach additional sheet if required)

EAP, Sarmastpur, Date 30/9/2022

Sr. No.	Name of the Participant	Age	Male / Female	First Preference of training	Second preference of training	Mobile Number	Signature of Participant
1	Amarjit Kaur	40	F			8868734447	Amarjit Kaur
2	Renu Bala	39	F			6239632583	Renu Bala
3	Sunita Rani	34	F			8968129152	Sunita Rani
4	Rajinder Kaur	51	F			9779300881	Rajinder Kaur
5	Kamaljeet Kaur	42	F			8146015287	Kamaljit Kaur
6	Narinder Kaur	45	F			9872012989	Narinder Kaur
7	Darshan Kaur	60	F			8146859460760	Darshan Kaur
8	Manjeet Kaur	43	F			9855088716	Manjeet Kaur
9	Subhdeep Kaur	33	F			9814297796	Gurdeep Kaur
10	Anju Bala	37	F			9465144966	Anju Bala
11	Manjeet Kaur	46	F			9463676871	Manjit Kaur
12	Parveen Kaur	28	F			98156 53041	Parveen Kaur
13	Balveer Kaur	55	F			9815047119	Balveer Kaur
14	Paramjeet Kaur	50	F			9779300881	Paramjeet Kaur
15	Jaswinder Kaur	29	F			9815342826	Jaswinder Kaur
16	Somnath	24	M			9815342826	.Somnath
17	Manpreet Kaur	26	F			-	Manpreet Kaur
18	Kanthyala Devi	52	F			9872854860	[illegible]
19	Kiran Bala	38	F			98786 47503	Kiran Bala
20	Sarbjeet Kaur	50	F			9872842903	[illegible]

ICICI Foundation

Attach Attendance of the participants on plain paper in following format and attach alongwith the EAP Report
(Attach additional sheet if required)

Sr. No.	Name of the Participant	Age	Male / Female	First Preference of training	Second preference of training	Mobile Number	Signature of Participant
21	Raj Rani	42	F			9915238467	Raj Rani
22	Sarabjeet Kaur	40	F			9915643113	Sarbjit Kaur

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Members of self help group attending session on EAP at Sarmastpur

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DAV University, Jalandhar

Faculty of Agricultural Sciences
DAV University, Jalandhar

Event Report

Name of the Event: Visit to the research farms and interaction with ICAR- IIW&BR, Karnal

Date: Feb., 4, 2020

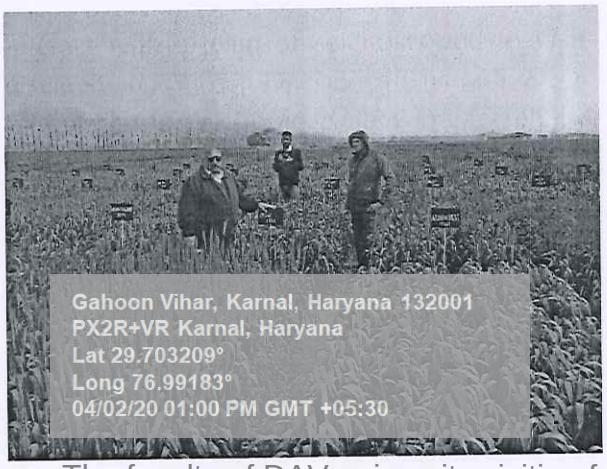
Organized by: Faculty of Agricultural Sciences, DAV University, Jalandhar and ICAR- Indian Institute of Wheat and Barley Research (ICAR- IIW&BR), Karnal

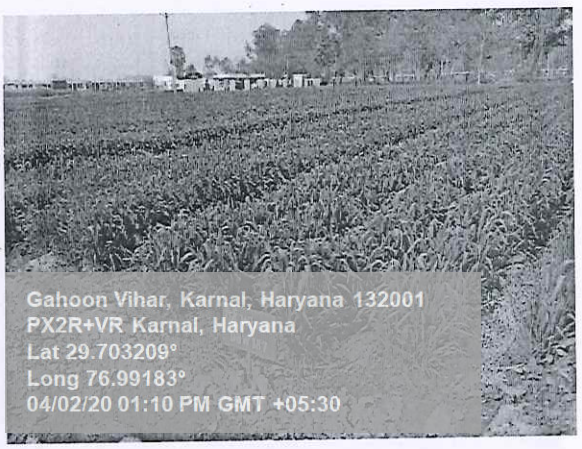
Name of organizer: Dr. (Prof.) Ravish Chatrath, Dean, Faculty of Agricultural Sciences

Brief Description of the Event:

Faculty members of Agricultural Sciences visited ICAR- IIW&BR, Karnal on Feb., 4, 2020 to interact with a team of scientists and to visit research farms and laboratories to see ongoing research activities. Dr Ravish Chatrath, Dean (Agri. Sciences) along with Dr. Ruhidas Ghatak (Agronomy), Dr. Pooja Rattan (Vegetable science) and Dr. Rupender Kamboj (Agricultural extension) interacted with Dr. R K Sharma, Dr. Gyanender Singh, Dr. Satyavir Singh, Dr. Sewa Ram, Dr. R. P. S. Verma, Dr. Sudhir Singh and Dr. Poonam Jasrotia. The scientists of the institute briefed on crop improvement activities with special reference to quality and value addition (Biscuit quality in wheat and fermented products from barley). They further explained the plant protection and extension activities in wheat and barley and planning, monitoring and coordination committees for smooth conduction of research within the mandate of ICAR, New Delhi. Later, the DAVU faculty visited the museum and research farm of the institute to further understand its history, development, projects and current research activities.

Photographs of the Event:





The faculty of DAV university visiting farms at IIW & BR

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DAV University, Jalandhar

Department of Electrical Engineering

Event Report

Name of Event: Visit to Punjab Energy Development Agency, Chandigarh

Date: 06/09/2024

Organized by: DAV University, Jalandhar

Name of Organizer: Dr. Chetan Vasudeva, Dr. Ashutosh Bhadoria, Ms. Simran Kaur

Place of Visit: Punjab Energy Development Agency, Chandigarh

No. of Participants: 21

Website Link:

https://www.peda.gov.in/#:~:text=Punjab%20Energy%20Development%20Agency%20was%20formed%20in%20Sept.%201991%20as

Brief Description of Event:

Students of Electrical Engineering visited Punjab Energy Development Agency(PEDA), Chandigarh. The students were given awareness about the initiatives being done by PEDA such as Promotion and Development of Small/Micro Hydel projects on canal falls, Biomass/Agro residue based power projects, Co-generation power project in Sugar Mills and Paper industry, Solar Photovoltaic and Solar thermal power projects, Waste to Energy projects, Solar Photovoltaic based technologies, Biomass based gasifiers, Solar thermal systems, Implementation of Energy Conservation Act, Biogas development programme through setting up large

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size Institutional/Night Soil based biogas plants and Family Size biogas plants, Energy conservation, Solar Passive Architecture, Creating Awareness & Publicity in masses to adopt Non-conventional Energy Sources and Energy Saving / Conservation. Students also visited the product display gallery in the premises also the PEDA building is being rated with 5 Star rating in Energy consumption by Bureau of Energy Efficiency(BEE).

List of Participants:

Sr. No.	Student Name	Regn. No
1	VAIBHAV	12400041
2	UPANSHU	12401098
3	MOHIT	12401587
4	ADITYA	12402057
5	JASPREET SINGH	12300260
6	K SUSHMITA	12300443
7	ARYAN KATNORIA	12300912
8	SUKHCHAIN SINGH	12301226
9	HARMAN BAINS	12402243
10	ASHISH	12200158
11	AKASHDEEP SINGH BHATTI	12201437
12	BIBHAKAR	12300270
13	DIVYA	12300331
14	DIKSHA	12300876
15	VISHAL	12100215
16	DHARAM PREET SINGH	12100229
17	DEEPAK KUMAR	12100230
18	KULVIR SINGH	12100625
19	HIMESH KUMAR	12100661
20	ARYAN THAKUR	12100977
21	JATIN SINGH	12101014

Programme Schedule:

Departure from University: 8:00AM

Arrival at PEDA: 11:30AM

Return to University: 8:30PM

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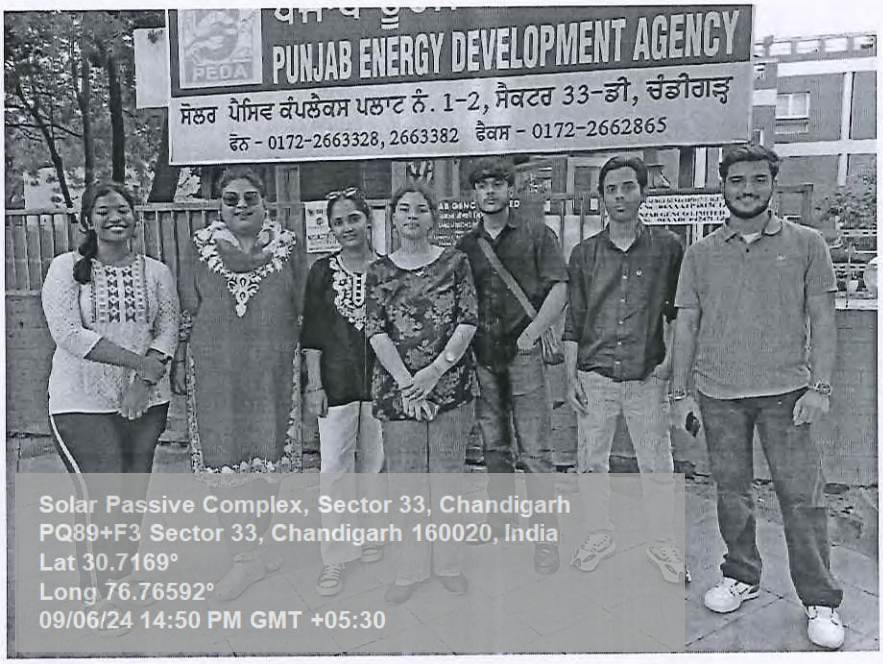

Complex, Plot No. 1&2, Sector-33D, Sector 33, Chandigarh, 160020

Students of DAV University at the PEDA campus

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Department of Mechanical Engineering

Event Report

Name of Event:	PEDA organizes training programme at DAV University on energy conservation
Date:	5-7, September 2018
Organized by:	DAV University, Jalandhar
Name of Organizer:	Dr. Rajesh Khanna
Venue:	DAV University,Jalandhar

Website Link:

https://www.davuniversity.org/news/peda-organises-training-programme-at-dav-university-on-energy-conservation-251

Brief Description of Event:

Various experts discussed the modalities for achieving optimum performance in institutional and commercial buildings for conserving energy at a training programme held at DAV University. The three-day training programme was organized by Punjab Energy Development Agency (PEDA) with the support of Bureau of Energy Efficiency (BEE) and UNDP. The experts said that ECBC specified the energy performance requirements for all commercial buildings which must be adhered to. Following ECBC would ensure the construction of energy efficient buildings reducing electricity demand by up to 40 percent.

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The training programme was inaugurated by Prof Rakesh Kumar Mahajan, Vice-Chancellor, DAV University. He said that every individual should optimise the use of energy to help the government's initiative effective.

Mr Randhir Singh, Senior Manager highlighted the initiatives of PEDA in energy conservation. BEE empanelled Energy Conservation Building Code (ECBC) Master Trainers Mr Kushagra Juneja and Mr Money Khanna also talked about energy conservation through proper structure design.

Dr Rajesh Khanna, Coordinator, University-Industry Linkage Cell, talked on the energy efficiency using Taguchi method evolved in Japan. Dr Khanna also deliberated on the steps taken by the university.

Mr Mandeep Singh from the Public Works Department (PWD) highlighted the working of lighting simulation software to conserve electricity. The simulator facilitates proper lighting design in buildings.

Those present at the programme included Dr Sushma Arya, Registrar, Dr. Desh Bandhu Gupta, Dean (Academics) and Dr. Jasbir Rishi, Dean Students' Welfare (DSW).

Felicitation of the expert from PEDA by the vice chancellor

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Certificate of Participation

Mr. / Ms. Dr. Chetan Vasudeva

from D.A.V. University

has participated in the

Three Days Capacity Building Training Program on

Punjab Energy Conservation Building Code (Punjab ECBC)

held on

5th – 7th Sept, 2018 at DAV University, Jalandhar

Organised by Punjab Energy Development Agency in association with

Design2Occupancy Services LLP.

ECBC Master Trainer

Design2Occupancy Services LLP

Punjab Energy Development Agency

Dr. Chetan Vasudeva attended Capacity Building Programme under Municipal Demand Side Management - 05th June 2020 - 11:00 AM – organized by PEDA

CERTIFICATE OF ATTENDANCE

WE HEREBY CERTIFY THAT

Chetan Vasudeva

has attended the Webinar on
"One Day Capacity Building Programme under
Municipal Demand Side Management"
organized by PEDA, BEE and supported by D2O
on June 5, 2020

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Faculty of Agricultural Sciences
DAV University, Jalandhar

Event Report

Name of the event: Visit to CSSRI, Karnal and interaction with scientists

Date: Feb., 4, 2020

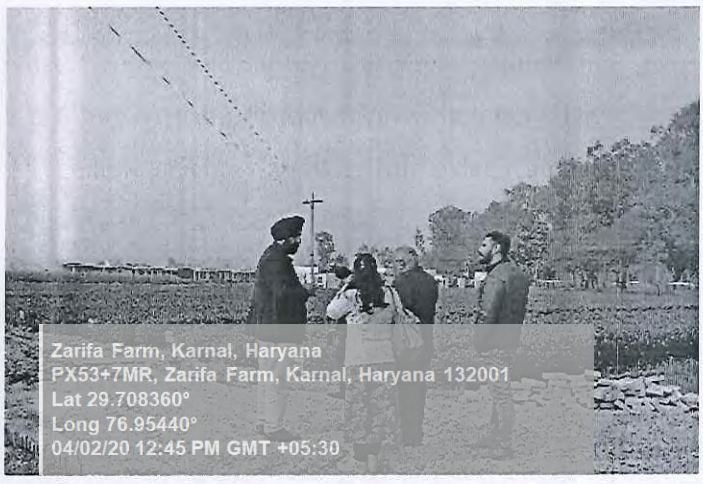
Organized by: Faculty of Agricultural Sciences, DAV University and Central Soil Salinity Research Institute

Name of organizer: Dr. Ravish Chatrath, Dean (Agri. Sciences), DAV University, Jalandhar

Brief Description of the Event:

The faculty members of Agricultural Sciences visited Central Soil Salinity Research Institute on Feb., 4, 2020 to interact with the scientists of the institute. A team of four faculty members, Dr. Ruhidas Ghatak (Agronomy), Dr. Pooja Rattan (Vegetable science) and Dr. Rupender Kamboj (Agricultural extension) with Dr Ravish Chatrath, Dean (Agri. Sciences) visited the research farms and laboratories of the institute. They interacted with scientists of different disciplines working on salt stress tolerance and facilities created in the institute for the screening and identification tolerant lines and salt stress management practices recommended by the institute.

Event photographs



The faculty of DAV University visiting CSSRI staff and at farm

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Mr. Bhag Ram
Sarpanch.

Village Sangowal, VPO-Kishangarh, Jalandhar, Punjab

Subject: Consent for the model development of Village Sangowal

This is with reference to the letter received from VC office, DAV University (Ref. No. VC/DAVU/2019/020 dated 27/09/2019) through Dr. Rahul Kumar, Assistant Professor, DAV University. I appreciate the initiative by DAV University and Punjab Research Innovation by Punjab Council of Science and Technology and Environment for selecting our village for the model development for the Mission Tandrust Punjab. On behalf of Village Panchayat, It will be my pleasure to welcome and work with DAV University and the mission for the model development of Village Sangowal.

Sincere Regards and thanks

Bhag Ram
12/10/19
Sarpanch
Gram Panchayat Sanghwal
Tehsil & Distt. Jalandhar

To

VC Office, DAV University, Jalandhar.

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Registrar
DAV University, Jalandhar

DAV UNIVERSITY

Office of the Vice-Chancellor

+91-181-270 8844 Telephone
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+91-181-270 8844 Fax
www.davuniversity.org Website

Ref. No. VC / DAVU / 2019 / 020 Dated 27.09.2019

The Sarpanch
Sangwal Village
Jalandhar

Dear Sir,

It gives me immense pleasure to inform you that the discussion held between DAV University and people representatives of Sangwal Village has fructified and authorities have agreed to work in your village to make it as model village in terms of air, water & soil quality, waste management, rain harvesting, zero burning of paddy straw, etc.

This proposal of adopting your village is a result of efforts made by the Punjab Council of Science, Technology and Environment under the Mission Tandrust Punjab. DAV University in association with Punjab Research Innovation will try to make all efforts to make Sangwal Village as a Model Village with the cooperation of Gram Panchayat. The details of the initiatives to be taken shall be mutually decided by DAV University and the village people.

You are, therefore, requested to send your acceptance to this piece of information so that an agreement to this effect is prepared for further necessary action.

Thanking you.

Yours sincerely,

27/9/19

(Prof. Desh Bhandu Gupta)
Offg. Vice Chancellor

ATTESTED

Registrar
DAV University, Jalandhar

Recieved by Sarpanch & Panchayat

Bhag Ram

Sarpanch
Gram Panchayat Sanghwal
Tehsil & Distt. Jalandhar

Chapter 14
PGPR and Earthworm-Assisted Phytoremediation of Heavy Metals

Pooja Sharma, Palak Bakshi, Jaspreet Kour, Arun Dev Singh, Shalini Dhiman, Pardeep Kumar, Ibrahim, Ashutosh Sharma, Bilal Ahmad Mir, and Renu Bhardwaj

Abstract The pronounced and major effects of contamination of the environment with heavy metals and other xenobiotic compounds have become a major problem worldwide. Soil contaminated with heavy metals poses serious threat to plants, animals as well as human health. Heavy metals due to their toxicity reduces the soil fertility, affects the plant photosynthetic efficiency, reduces yield of the crops, and causes nutrient imbalance. Phytoremediation an eco-friendly, clean, and green technology helps to remove contaminants from the polluted soils. The use of beneficial microorganisms along with plants is considered as an effective method for increasing the efficiency of remediation of contaminated soils. Earthworms also play an important role in remediation process. Interaction of plants with microflora plays a vital role in bioavailability of the metals and their bioaccumulation in plants.

Keywords Plant growth-promoting rhizobacteria · Earthworms · Fungi · Heavy metal · Plants

P. Sharma
Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India

Department of Microbiology, DAV University, Jalandhar, Punjab, India

P. Bakshi · J. Kour · A. D. Singh · S. Dhiman · P. Kumar · Ibrahim · R. Bhardwaj (✉)
Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India

A. Sharma
Department of Agriculture Sciences, DAV University, Jalandhar, Punjab, India

B. A. Mir
Department of Botany, School of Life Sciences, Satellite Campus Kargil, University of Kashmir, Srinagar, Jammu and Kashmir, India

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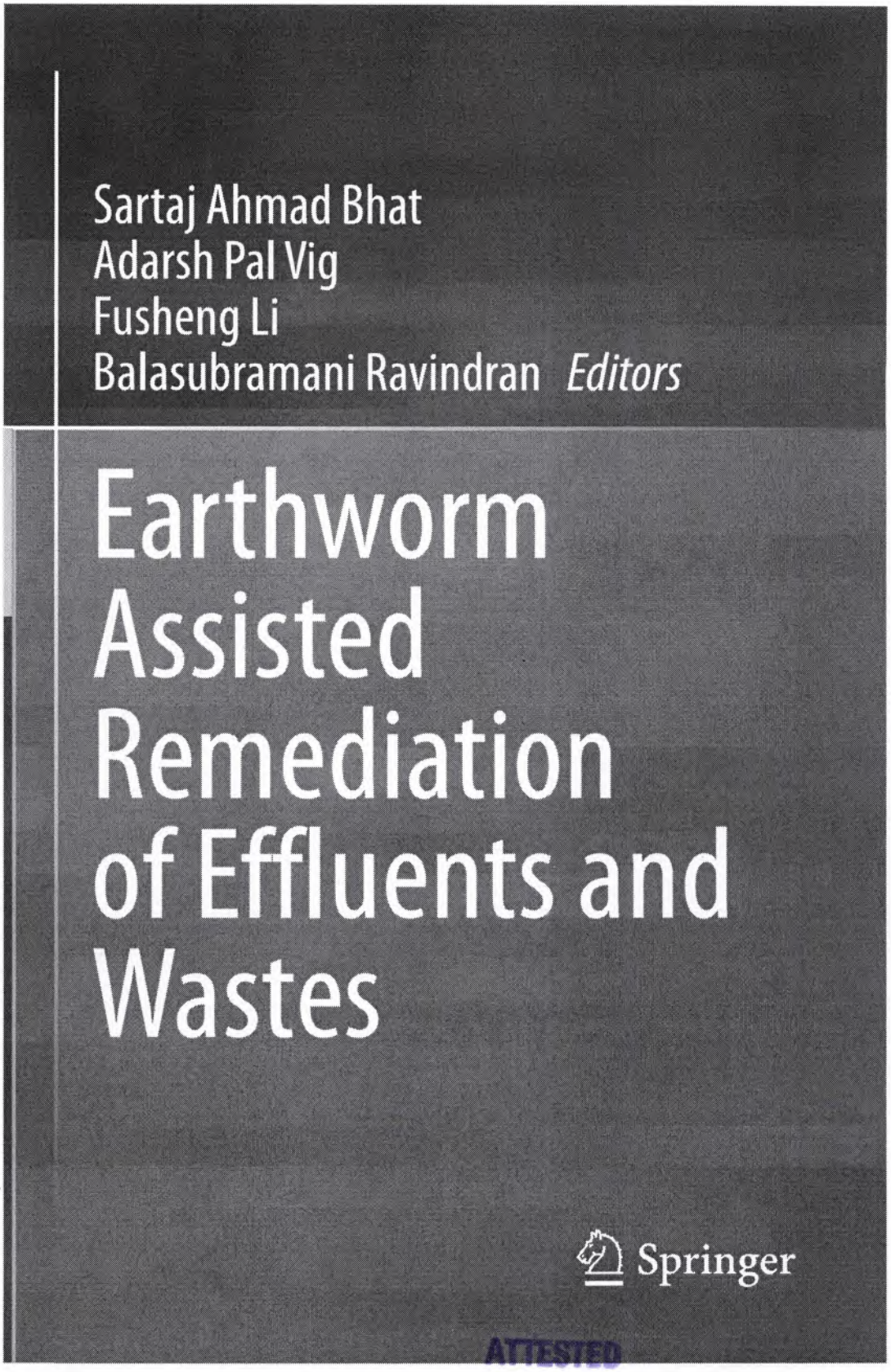

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Hydrogen Sulfide in Plant Biology
Past and Present
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Chapter 15 - Hydrogen sulfide and phytohormones crosstalk in plant defense against abiotic stress

Jaspreet Kour [1], Kanika Khanna [1], Pooja Sharma [1 2], Arun Dev Singh [1], Indu Sharma [3], Priya Arora [1], Pardeep Kumar [1], Kamini Devi [1], Mohd Ibrahim [1], Puja Ohri [4], Bilal Ahmad Mir [5], Ashutosh Sharma [6], Renu Bhardwaj [1]

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Abstract

Global developmental strategies and population expansion are continuously showing their odd impacts on the living world, thereby causing stresses of multiple natures. To combat these stresses, hydrogen sulfide (H_2S) is well-examined signaling molecule that acts as a priming agent and helps in regulating the response of plants to various stressful conditions. Hydrogen sulfide is formed in the plant cells as an intermediate of an assimilatory sulfate reduction. Despite the endogenous release of hydrogen sulfide, its exogenous application has been found to be beneficial in the amelioration of multiple abiotic stresses. These responses are also mediated by the expression of genes and proteins that participate in signaling and metabolic pathways induced through several small signaling molecules known as plant hormones or phytohormones. Phytohormones are also found to be involved in regulation of the protective responses under various abiotic and biotic stress conditions. H_2S in crosstalk with these phytohormones significantly ameliorates the abiotic stress in plants. In this chapter we have discussed in detail how H_2S in crosstalk with phytohormones helps in the enhancement of defense against abiotic stress in plants.

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The Interplay between Hydrogen Sulfide and Phytohormone Signaling Pathways under Challenging Environments
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Hydrogen Sulfide in Plant Biology

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Thiol Assisted Metal Tolerance in Plants

Pooja Sharma[1,2], Palak Bakshi[1], Dhriti Kapoor[3], Priya Arora[1], Jaspreet Kour[1], Rupinder Kaur[4], Ashutosh Sharma[5], Bilal Ahmad Mir[6] and Renu Bhardwaj[1]

[1]*Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India*
[2]*Department of Microbiology, DAV University, Jalandhar, Punjab, India*
[3]*Department of Botany, School of Bioengineering and Biosciences, Lovely Professional University, Phagwara, Punjab, India*
[4]*Department of Biotechnology, DAV College, Amritsar, Punjab, India*
[5]*Faculty of Agricultural Sciences, DAV University, Jalandhar, Punjab, India*
[6]*Department of Botany, School of Life Sciences, Satellite Campus Kargil, University of Kashmir, Ladakh, India*

19.1 Introduction

Heavy metals occur naturally in the soil, however a large amount of these metals are released to the environment by various geological and anthropogenic activities like rapid industrialization, extensive use of pesticides and fertilizers in agricultural lands, mining, smelting, sewage sludge [1]. Owing to their long persistence and nondegradable nature, their accumulation has sheer increased in agricultural soils and environment. Heavy metals are toxic to the cells even at genetic level by causing various mutations, consequently prove toxic to plants, animals, contaminate food chains and food webs [2, 3]. Some of the heavy metals like Fe, Zn, Ni, Co, Mn, Cu, Mo are essential micronutrients for various metabolic processes of plants but their excessive amounts are harmful. Metals such as As, Cd, Cr, Hg and Pb are not beneficial for the plant and alter the physiological and biochemical metabolism of the plants which eventually result in reduced crop yield [4, 5]. Exposure of plants to heavy metals cause oxidative stress due to excessive production of reactive oxygen species (ROS) such as superoxide (O_2-), hydroxyl radical (OH-), singlet oxygen ($1O_2$), and hydrogen peroxide (H_2O_2) Ojuederie and Babalola [6].

Among different strategies adopted by plants to overcome stress, various evidences have emerged which focus on the number of non-protein and protein thiols to combat stress [7]. The sulfur-containing amino acids cysteine (Cys), methionine (Met), the tripeptide glutathione play important role in abiotic stress tolerance [8]. Thiols work as redox buffer and protect the components of cells from ROS and play important role in plant adaptation to stress. Plants have large range of reduced sulfur in the form of protein thiols or low molecular weight (LMW) thiols present in the biomolecules like proteins, vitamins, antioxidants, cofactors, and metal binding proteins. Plants take up the sulfur from the soil in the form of sulfate which is reduced to sulfide and finally incorporated into cysteine. It is quickly incorporated in proteins or transformed into other compounds primarily methionine (Met) and glutathione (GSH). Thiol group (-SH) incorporated either in proteins (cys-residues) or its existence as non-protein thiol tends to be oxidized forming disulphides (S-S). This disulphide status in proteins is of utmost importance as

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Chapter 18

Nanobioremediation: a novel technology with phenomenal clean up potential for a sustainable environment

Tamanna Bhardwaj[1], Kanika Khanna[1], Pooja Sharma[1,2], Palak Bakshi[1,3], Kamini Devi[1], Isha Madaan[4], Shruti Kaushik[4], Geetika Sirhindi[4], Bilal Ahmad Mir[3], Rupinder Kaur[5], Ashutosh Sharma[6], Puja Ohri[7] and Renu Bhardwaj[1]

[1]Plant Stress Physiology Lab, Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India, [2]Department of Microbiology, DAV University, Jalandhar, Punjab, India, [3]Department of Botany, School of Life Sciences, University of Kashmir, Satellite Campus, Kargil, Ladakh, Jammu and Kashmir, India, [4]Department of Botany, Punjabi University, Patiala, Punjab, India, [5]Department of Biotechnology, DAV College, Amritsar, Punjab, India, [6]Faulty of Agricultural Sciences, DAV University, Jalandhar, Punjab, India, [7]Department of Zoology, Guru Nanak Dev University, Amritsar, Punjab, India

18.1 Introduction

Nanobioremediation is a contemporary consolidated technology which includes both nanotechnology and bioremediation. It has got best of both technologies which makes nanobioremediation highly efficient and environment friendly approach (Singh et al., 2020). Toxicity of Nanoparticles for microorganisms is very well cited in the literature, but the right dose of nanoparticles plays critical role (Li et al., 2010). It was reported by Le et al. (2015) that with the help of nano-bio approach, polychlorinated biphenyls (PCBs) were effectively bioremediated with *B. xenovorans* and Pd/Fe nanoparticles. Another similar study conducted by Němeček et al. (2016), stated that nZVI and whey generated microbes removed 97%–99% of Cr (VI) in an integrated system. On basis of the sequence for applying the nanoparticle and bioagent, mainly two methods are designed namely sequential method and concurrent or combined method. In sequential method, contaminant is first treated with nanoparticles followed by bioagent. Whereas, in concurrent or combined method both the components i.e., bioagent and nanoparticles are added simultaneously (Singh et al., 2020). Biogenic nanoparticles are synthesized from Algal, Fungal and Bacterial agents. They are synthesized using intracellular or by extracellular processes. In intracellular processes, diffusion of positively charged metal ions takes place into negatively charged cell wall by electrostatic interactions. While in extracellular processes, enzymes secreted by fungus convert metal ions into metal nanoparticles (Menon et al., 2017). In another study, Sundaram et al., 2012 reported production of iron oxide nanoparticles by *Bacillus subtilis*, isolated from rhizosphere soil samples. Similarly, Menon et al. (2017) stated that fungal cells are capable of producing gold nanoparticles (AuNPs). Brown algae are engaged in biosynthesis of nanoparticles, since it is rich in mucilaginous polysaccharides and carboxyl groups. They assist in metal uptake and hence are used for production of nanoparticles (Khandel and Shahi, 2016). Microorganisms being biological entity, serves as a cost-effective renewable source for environmental remediation (Narayanan and Sakthivel, 2011). Various laboratory-based studies and field-level application of biogenic nanoparticles are conducted to clear away environmental toxins. Microbe mediated nanobioremediation is used to target heavy metals, hydrocarbons, dyes, pharmaceuticals as they adversely pollute natural resources. In recent study, it was reported that iron nanoparticles synthesized from natural consortium had ability to efficiently absorb copper, zinc and chromium from wastewaters (Castro et al., 2013). Biogenic manganese oxides (BMO) were manufactured using *Pseudomonas putida* MnB1 for eradication of heavy metals. Zhou et al., 2015 reported that BMO adsorbed heavy metals better than the chemically synthesized manganese oxide. Aziz et al., 2015 stated that biogenic AgNPs (silver nanoparticle) synthesized using *Chlorella pyrenoidosa* productively degrades Methylene blue (MB) dye, an obstinate toxic organic compound. Another study came up

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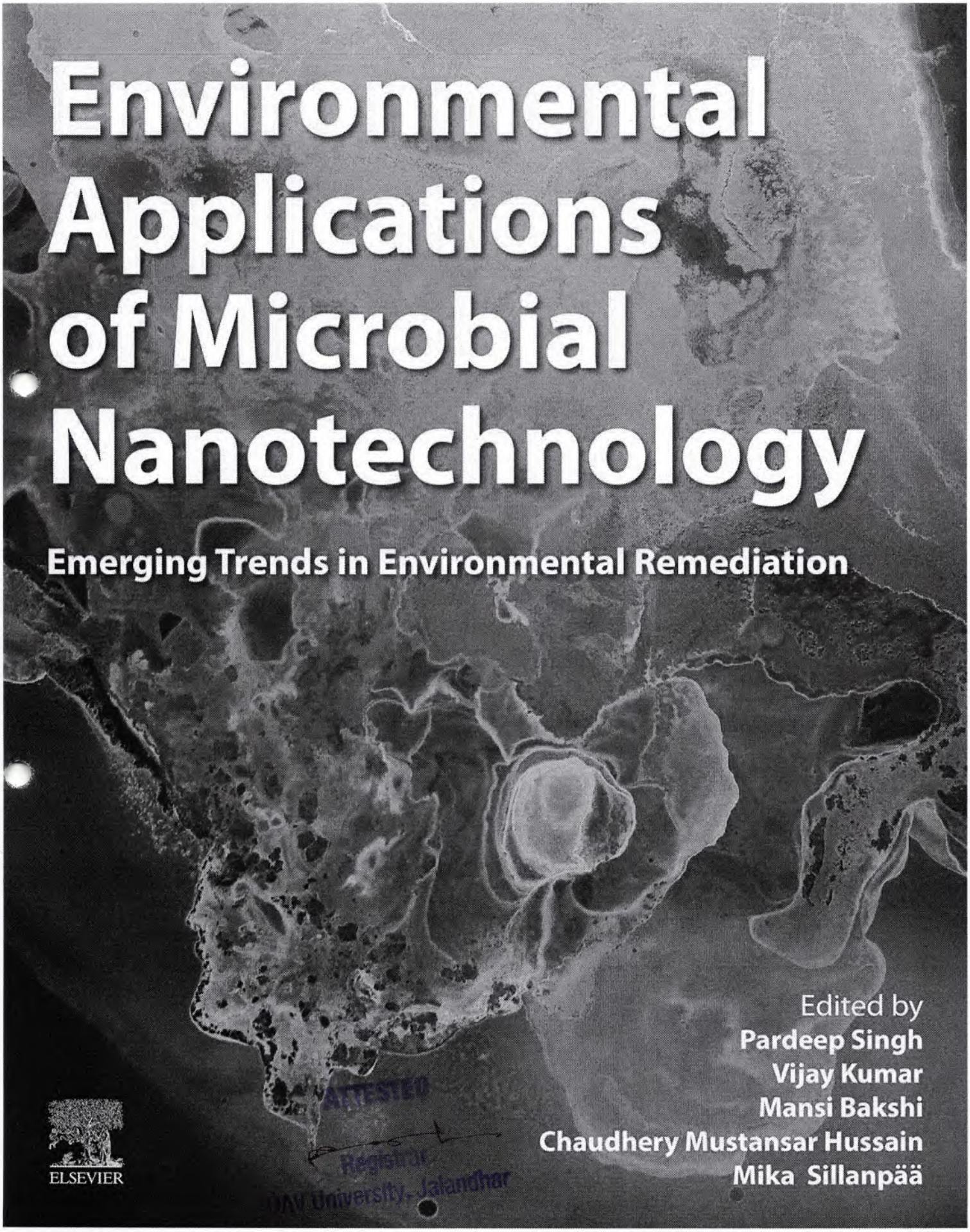
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Brassinosteroids Signalling

Palak Bakshi, Shagun Bali, Pooja Sharma, Mohd Ibrahim, Kamini Devi, Neerja Sharma, Ashutosh Sharma, Amrit Pal Singh, Bilal Ahmad Mir & Renu Bhardwaj

Abstract

Inapt usage of pesticides adversely affects the growth and development of the plants. Pesticides not only target the target species but also hampered the life cycle of nontarget species. The oxidative burst in plants with the generation of enhanced reactive oxygen species (ROS) has a detrimental effect on various physiological and biochemical mechanisms of plants which resulted in stunted growth, chlorosis, blackening of roots, accumulation of pesticides in plant parts, and decreased photosynthetic potential. Plants have the potential to withstand the stress conditions by activating different defense mechanisms like antioxidative defense system—enzymatic and nonenzymatic. Brassinosteroids (BRs) are the plant steroidal hormones known for their potential to

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P. Sharma
Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India

Department of Microbiology, DAV University, Jalandhar, Punjab, India

P. Bakshi · J. Kour · A. D. Singh · S. Dhiman · P. Kumar · Ibrahim · R. Bhardwaj (✉)
Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India

A. Sharma
Department of Agriculture Sciences, DAV University, Jalandhar, Punjab, India

B. A. Mir
Department of Botany, School of Life Sciences, Satellite Campus Kargil, University of Kashmir, Srinagar, Jammu and Kashmir, India

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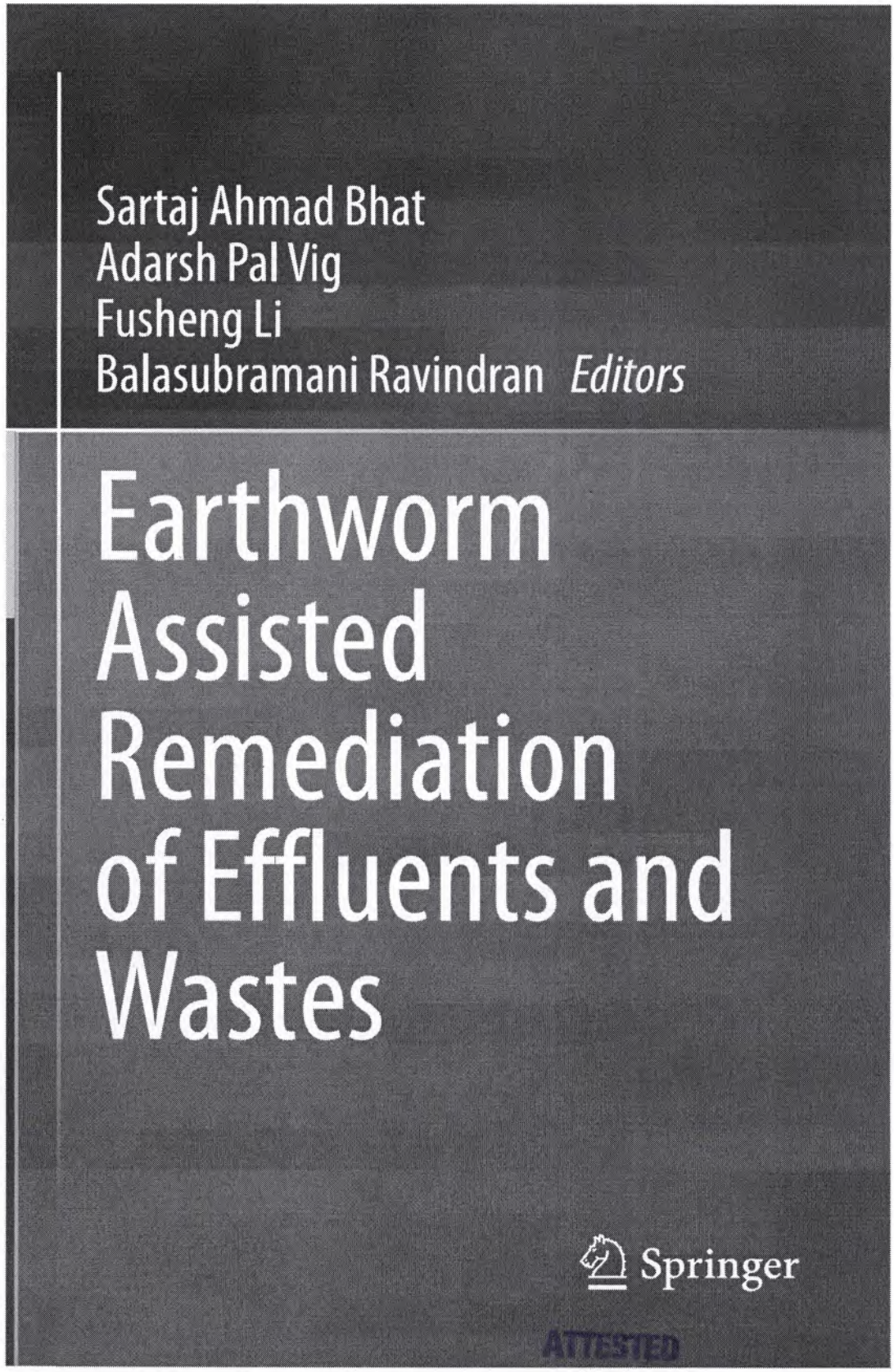

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Adarsh Pal Vig
Botanical and Environmental Sciences
Guru Nanak Dev University
Punjab, India

Balasubramani Ravindran
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Chapter 15 - Hydrogen sulfide and phytohormones crosstalk in plant defense against abiotic stress

Jaspreet Kour [1], Kanika Khanna [1], Pooja Sharma [1 2], Arun Dev Singh [1], Indu Sharma [3], Priya Arora [1], Pardeep Kumar [1], Kamini Devi [1], Mohd Ibrahim [1], Puja Ohri [4], Bilal Ahmad Mir [5], Ashutosh Sharma [6], Renu Bhardwaj [1]

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[2]*Department of Microbiology, DAV University, Jalandhar, Punjab, India*
[3]*Department of Botany, School of Bioengineering and Biosciences, Lovely Professional University, Phagwara, Punjab, India*
[4]*Department of Biotechnology, DAV College, Amritsar, Punjab, India*
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Chapter 18

Nanobioremediation: a novel technology with phenomenal clean up potential for a sustainable environment

Tamanna Bhardwaj[1], Kanika Khanna[1], Pooja Sharma[1,2], Palak Bakshi[1,3], Kamini Devi[1], Isha Madaan[4], Shruti Kaushik[4], Geetika Sirhindi[4], Bilal Ahmad Mir[3], Rupinder Kaur[5], Ashutosh Sharma[6], Puja Ohri[7] and Renu Bhardwaj[1]

[1]Plant Stress Physiology Lab, Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India, [2]Department of Microbiology, DAV University, Jalandhar, Punjab, India, [3]Department of Botany, School of Life Sciences, University of Kashmir, Satellite Campus, Kargil, Ladakh, Jammu and Kashmir, India, [4]Department of Botany, Punjabi University, Patiala, Punjab, India, [5]Department of Biotechnology, DAV College, Amritsar, Punjab, India, [6]Faulty of Agricultural Sciences, DAV University, Jalandhar, Punjab, India, [7]Department of Zoology, Guru Nanak Dev University, Amritsar, Punjab, India

18.1 Introduction

Nanobioremediation is a contemporary consolidated technology which includes both nanotechnology and bioremediation. It has got best of both technologies which makes nanobioremediation highly efficient and environment friendly approach (Singh et al., 2020). Toxicity of Nanoparticles for microorganisms is very well cited in the literature, but the right dose of nanoparticles plays critical role (Li et al., 2010). It was reported by Le et al. (2015) that with the help of nano-bio approach, polychlorinated biphenyls (PCBs) were effectively bioremediated with *B. xenovorans* and Pd/Fe nanoparticles. Another similar study conducted by Němeček et al. (2016), stated that nZVI and whey generated microbes removed 97%–99% of Cr (VI) in an integrated system. On basis of the sequence for applying the nanoparticle and bioagent, mainly two methods are designed namely sequential method and concurrent or combined method. In sequential method, contaminant is first treated with nanoparticles followed by bioagent. Whereas, in concurrent or combined method both the components i.e., bioagent and nanoparticles are added simultaneously (Singh et al., 2020). Biogenic nanoparticles are synthesized from Algal, Fungal and Bacterial agents. They are synthesized using intracellular or by extracellular processes. In intracellular processes, diffusion of positively charged metal ions takes place into negatively charged cell wall by electrostatic interactions. While in extracellular processes, enzymes secreted by fungus convert metal ions into metal nanoparticles (Menon et al., 2017). In another study, Sundaram et al., 2012 reported production of iron oxide nanoparticles by *Bacillus subtilis*, isolated from rhizosphere soil samples. Similarly, Menon et al. (2017) stated that fungal cells are capable of producing gold nanoparticles (AuNPs). Brown algae are engaged in biosynthesis of nanoparticles, since it is rich in mucilaginous polysaccharides and carboxyl groups. They assist in metal uptake and hence are used for production of nanoparticles (Khandel and Shahi, 2016). Microorganisms being biological entity, serves as a cost-effective renewable source for environmental remediation (Narayanan and Sakthivel, 2011). Various laboratory-based studies and field-level application of biogenic nanoparticles are conducted to clear away environmental toxins. Microbe mediated nanobioremediation is used to target heavy metals, hydrocarbons, dyes, pharmaceuticals as they adversely pollute natural resources. In recent study, it was reported that iron nanoparticles synthesized from natural consortium had ability to efficiently absorb copper, zinc and chromium from wastewaters (Castro et al., 2013). Biogenic manganese oxides (BMO) were manufactured using *Pseudomonas putida* MnB1 for eradication of heavy metals. Zhou et al., 2015 reported that BMO adsorbed heavy metals better than the chemically synthesized manganese oxide. Aziz et al., 2015 stated that biogenic AgNPs (silver nanoparticle) synthesized using *Chlorella pyrenoidosa* productively degrades Methylene blue (MB) dye, an obstinate toxic organic compound. Another study came up

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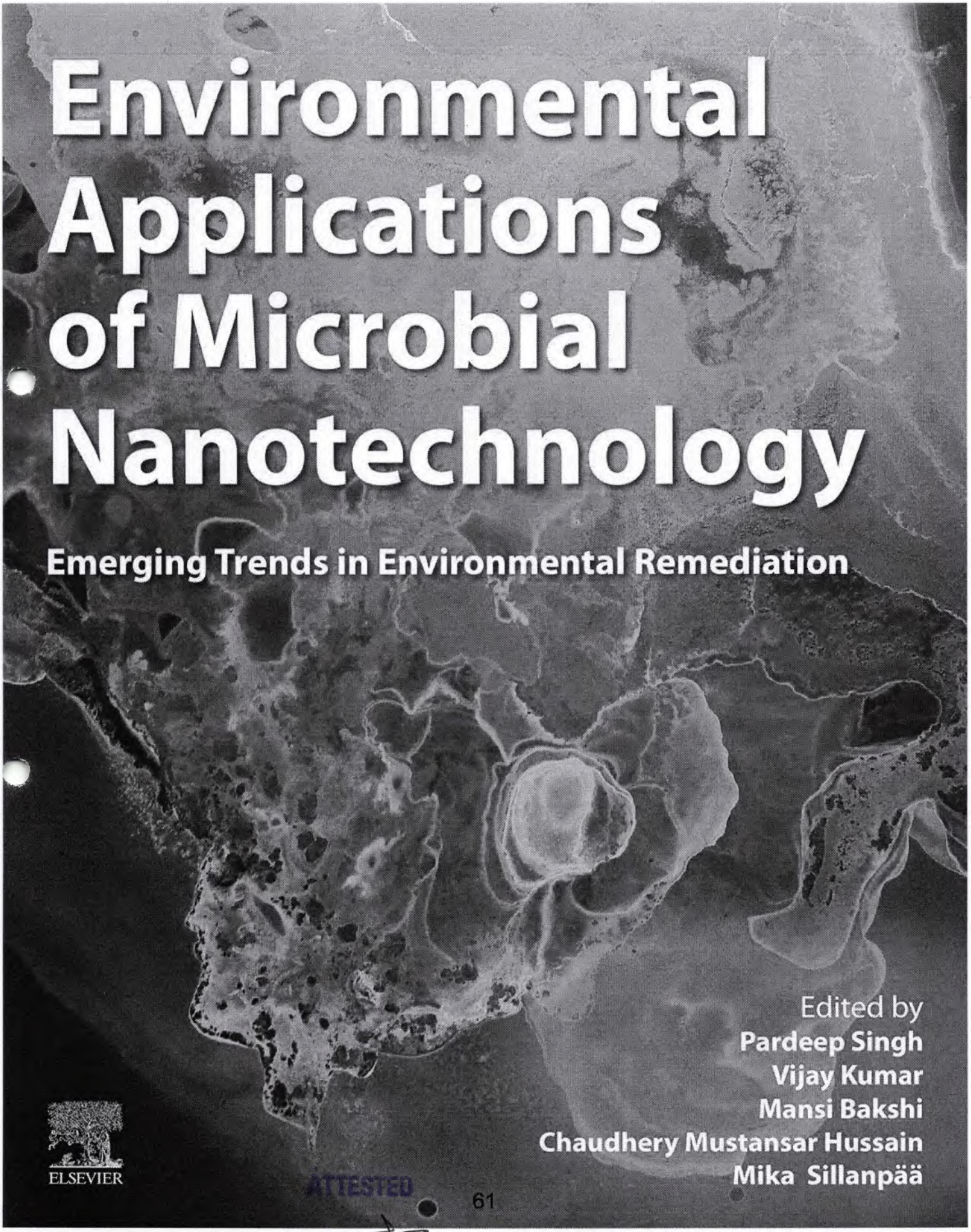

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Research Papers

Enhanced photocatalytic degradation of Rhodamine B and Methylene blue by novel TiO_2/SnSe-SnO_2 hybrid nanocomposites under sunlight irradiation: Correlation of photoluminescence property with photocatalytic activity

Vandana Bagga [a], Narveer Singh [b], Manika Khanuja [c], Mamta Rani [a], Daljit Kaur [a,*]

[a] Department of Physics, DAV University, Jalandhar, India
[b] Department of Physics, Lyallpur Khalsa College Jalandhar, India
[c] Centre for Nanoscience & Nanotechnology, Jamia Millia Islamia, New Delhi, India

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ABSTRACT

Semiconducting nanocomposites (NCs) has proved their dominance in various energy applications. The facile chemical synthesis of semiconducting hybrid NCs of TiO_2 nanoparticles with SnSe/SnO_2 (SS) nanostructures has been carried out. Structural, morphological, compositions, optical and photo-catalytic (PC) properties of the synthesized materials were then studied by various characterization techniques. The hybrid NC of TiO_2 nanoparticles grown with addition of 0.5 g of SS nanostructures has been observed to exhibit the best PC activity among the other samples. The fitted photoluminescence (PL) spectra of pristine TiO_2 when compared with the other two TiO_2 -SS hybrid NCs showed that the oxygen vacancy (OV) defects play a major role in enhancing the PC property. The samples with superior PC activities have higher intensity of PL emission peak from OVs, efficient charge separation owing to longer lifetime of free charge carriers deduced from time-resolved PL studies and higher surface area.

1. Introduction

The toxicity and hazardous chemicals in water from last few decades has attracted attention towards the increasing environmental pollution in various parts of the world. Mainly dyes are responsible for water pollution that is used in food, textiles, cosmetics, leather industries etc. There are various methods used for the degradation of dyes like chemical, oxidation, chemical ion exchange, coagulation- flocculation, electrocoagulation, electrooxidation, vacuum evaporation, membrane filtration photocatalysis and absorption [1–7]. Photocatalysis is a highly efficient cost-effective method that degrades these toxic pollutants to harmless minerals using green and abundant solar energy on the surface of a photocatalyst [8–11]. An efficient photocatalyst must have an optimum band gap value, slow charge recombination and high surface area to facilitate the photocatalysis process [12–14]. The photocatalysts are generally semiconductor materials that absorb light radiation to produce electron-hole pair which helps in formation of free radicals that are responsible for oxidation of long-chain organic molecules. Titanium dioxide has become one of the best choices as photocatalyst because of its low cost, high chemical stability, good oxidizing power, non toxic nature and good photocatalytic efficiency. TiO_2 is used in various applications such as photo catalysts, photovoltaics, photosensors, paints, toothpaste, ointments, sun screen, self cleaning surface, water splitting, water purification, air cleaning, solar cell and batteries [15,16]. TiO_2 could absorb the light of wavelengths lower than 387 nm due its large band gap (3.0 – 3.5 eV). It absorbs light only in ultraviolet region and only small fraction of solar light can be absorbed by TiO_2 as less than 5% of solar energy is emitted as UV irradiation. The solar radiation that reaches the earth consists of 42–43% of visible light. There have been many efforts done to extend the activity of TiO_2 into visible light region and enhance its photo catalytic efficiency [17]. The literature reports show that the optical absorption and photocatalytic performance of TiO_2 has been improved by doping, mixing with other highly porous and matching band edge semiconductors [18–23]. The coupling of low band gap semiconductor with TiO_2 to form a nanocomposite (NC) also called as heterogenous catalyst, which can absorb both UV and the visible light

* Corresponding author.
E-mail address: daljitkhehra@gmail.com (D. Kaur).

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